NOVAS Changes 2006

The differences between NOVAS F2.9c and NOVAS F3.0d are:

(1) P03 precession is implemented in F3.0d. This affects PRECES, SIDTIM, and ETILT. NOVAS uses, in PRECES, the canonical 4-angle version of P03. (Formulas 5.7-5.9 in Circular 179; or Capitaine, et al. 2003, A&A 412, 567, section 7.2; or Hilton et al. 2006, precession WG report, Celest. Mech. Dyn. Astr. 94, 351.)

(2) The reference points "Celestial Ephemeris Origin (CEO)" and "Terrestrial Ephemeris Origin (TEO)" are now referred to as the "Celestial Intermediate Origin (CIO)" and "Terrestrial Intermediate Origin (TIO)", as recommended by the IAU Working Group on Nomenclature for Fundamental Astronomy. All subroutine names and variable names containing "CEO" or "TEO" have been changed to "CIO" and "TIO", respectively. This affected about 100 items. This includes the name of the file of external CIO coordinates, which is now CIO_RA.TXT.

(3) Subroutine EQECL for equatorial to ecliptic conversion has been divided up internally although its calling sequence has not been changed. EQECL works on spherical coordinates (RA & Dec to ecliptic long & lat) although internally it uses a vector rotation. The vector rotation was split off into a new, separate subroutine called EQEC, so that vectors can be converted. There is also now the reciprocal subroutine ECEQ.

(4) Within SOLSYS, the call to the JPL ephemeris-access routine has been changed from the single-argument JD call to the double-argument JD call — that is, from PLEPH to DPLEPH. The way SOLSYS now works is that if you give it a full JD, it just splits the integer part from the fractional part and sends these to DPLEPH separately. In this case the result is the same as a call to PLEPH with the JD in one piece. But, there is now a little bit of code so that if in a subsequent call to SOLSYS, the JD is between −1 and +1, SOLSYS will interpret it as a fraction of a day to be used with the integral part of the JD from a previous call. This way there is no effect on existing applications that directly use SOLSYS, but it provides a higher-precision option if two calls in succession are used in this way. The way to test whether SOLSYS can use split JDs is to check on whether the value of IDSS('JD') is 1 or 2, with 2 meaning that Julian dates can be split between successive calls. This means that IDSS has also been modified for this option.

(5) LITTIM has been modified to use the split-JD option in SOLSYS when available.

(6) A new subroutine, EQXRA has been added that evaluates the "Equation of the Origins" from an analytical expression. The expression is simply everything other than the first (fast) term in sidereal time (i.e., the non-ERA part) — that is, the accumulated precession and nutation in RA. This is comprised of the precession-in-RA polynomial plus the equation of the equinoxes, the latter including the "complementary terms". SIDTIM was modified to call EQXRA to compute all of that.

(7) But the real purpose of EQXRA was for use by CIOLOC, which was formerly called CEORAI. The purpose of CIOLOC is to "locate" the CIO and it can now do that in two ways; an extra output argument, K, indicates which way was used. If the file of CIO right ascension values is available (nominally called 'CIO_RA.TXT') then CIOLOC will provide the GCRS right ascension of the CIO, and will set K to 1. If the file is not available then CIOLOC will provide the arc on the instantaneous equator from the equinox to the CIO, and will set K to 2. To do the hard work, CIOLOC calls either CIORD (for K=1) or EQXRA (for K=2). Note that the old and somewhat ad hoc series approximation that was embedded in CEORA is now gone.

(8) Within NOVAS, the old CEORA was always used together with CEOBAS. With the change of names, the pairing is now CIOLOC and CIOBAS. CIOBAS now takes an extra input argument, K, passed from CIOLOC. CIOBAS has been altered to work with either kind of CIO location parameter provided by CIOLOC. That is, extra code was added to handle the K=2 case. The output basis vectors from CIOBAS are, however, the same (to within a few microarcseconds) in either case.

(9) Some INQUIRE statements were added to CIORD, which reads the file of CIO right ascensions, to check on the existence of the file before attempting to open it. A new error message and error code were added, to be used if the file is not found. Also, now, CIORD regards a call with TJD=0.D0 and NVALS=1 as a special call that simply checks on the existence of the file of CIO right ascensions and returns IERR=0 if it is present and IERR=4 if not. Nothing else is done in that case, and an error message is *not* displayed if IERR=4. This is how CIOLOC determines which way it will use to locate the CIO.

(10) A thorough scrub of the comments was done to make sure that "ICRS" was being used appropriately. In about half the cases it was changed to "GCRS". The name of subroutine ICRSEQ was changed to GCRSEQ.

(11) The double-Julian date argument to subroutine GEOPOS (TT and TDB) has been changed to a single TT Julian date argument. Internally, GEOPOS now sets TDB=TT, which is plenty good enough for what it does. Errors caused by neglecting polar motion are much larger than the errors caused by this time approximation, but neither is important.

(12) Major changes to the output of PLACE: The output parameters are now all contained in an array called SKYPOS. The unit vector toward the object comprises the first three elements of SKYPOS, followed by the RA (in hours) in element 4, dec (in degrees) in element 5, and true distance (for planets, in AU) in element 6. Element 7 now contains the radial velocity (in km/sec), which is new (see below).

(13) Subroutines PLACES and MPSTAR have been changed to accommodate the new output array SKYPOS in PLACE. There are 4 calls to PLACE in PLACES and 1 call to PLACE in MPSTAR.

(14) New subroutine RADVL has been added to compute radial velocity. It is called from PLACE. Currently, RADVL has just a simple classical formula for radial velocity but that will soon be changed to the more complex and relativistically correct formulas from the Lindegren and Dravins A&A paper cited in the comments. The Lindegren & Dravins formulas are in accordance with an IAU resolution on the definition of radial velocity passed in 2000.